

LA-UR-22-20476

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Title: Operation Upshot-Knothole

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Intended for: NSRC Test History
Report

Issued: 2022-01-20



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Operation Upshot-Knothole

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A thundering boom and sheet of fire announced a dramatic, once in a lifetime event – the firing of a nuclear projectile from a 280 mm cannon. Travelling seven miles downrange, the projectile detonated 500 feet over the Nevada Test Site’s Frenchman Flat with a force of fifteen kilotons. Although the test was successful, the massive cannon, designed for tactical battlefield use, had a critical flaw. It was too large and cumbersome for mobile combat.¹

The cannon test, codenamed Grable, was part of Operation Upshot-Knothole, the fourth test series conducted in Nevada. Beginning with the Annie test on March 17, 1953, and concluding with the Climax test on June 4th, the Operation consisted of three airdrops, seven tower detonations, and the one artillery shot. As with previous Nevada tests, the demarcation between the weapon development series, Upshot, and the DOD effects tests, Knothole, was blurred. All eleven tests generated data in support of weapon development as well as tactical battlefield applications.²

During Upshot-Knothole, the University of California Radiation Laboratory (UCRL), conducted its first ever tests, Ruth and Ray. Although neither test was successful, these failures, along with another a year later at Operation Castle, provided the new laboratory with design data leading to future successful tests. The Federal Civil Defense Administration (FCDA) participated in a test series with the general goal of preparing for societal recovery from a nuclear attack. Known as Operation Doorstep, the FCDA’s experiments evaluated the effects of a nuclear attack on food supplies, housing and urban structures, and even a copse of trees transplanted from nearby Mt. Charleston.³

A contingent of the press witnessed test Annie from an outcropping of rocks, subsequently named News Nob. The presence of the news media, along with the FCDA’s participation, marked a fundamental change in the Nevada test program - a change that now included the general populace, whose survival was, of course, the rationale for testing.⁴

The Department of Defense continued and expanded its Desert Rock exercises of troop exercises, helicopter operations, and evaluation of blast damage to military aircraft, tanks, and

¹ *Atomic Annie*, Nevada National Security Test Site, DOE/NV-776, August 2013. The cannon was nicknamed “Atomic Annie.”

² Jean Ponton, et.al, Operation Upshot-Knothole, 1953, Washington, DC: Defense Nuclear Agency), 1; and DOE/NV-209 – Rev 16, 4.

³ Hopkins, John C. and Barbara Germain Killian, Nuclear Weapon Testing at the Nevada Test Site; The First Decade. Fort Belvoir, Virginia: Defense Threat Reduction Agency, 302-307.

⁴ Ibid.

guns.⁵ Annie, Nancy, Badger, Simon, Encore, and Grable involved larger numbers of personnel than the other five shots. Below is an edited and condensed account of Desert Rock activities compiled by the Defense Threat Reduction Agency.⁶

Annie, a 300-foot tower detonation, was fired with a yield of 16 kilotons at 5:20 a.m. Pacific Standard Time (PST) on March 17, 1953, in Area 3 of Yucca Flat. The AEC designated ANNIE an "open shot," which allowed reporters to view the detonation from News Nob, 12 kilometers (7.5 miles) south of the shot tower. In addition, 20 reporters were selected to accompany the troops to the trenches, located 3.2 kilometers (2 miles) southwest of the tower.

Besides the tactical maneuver troops, an estimated 505 personnel from various services participated in the orientation and indoctrination program, which consisted of instruction in nuclear weapons, observation of the detonation, and a post-shot tour of the display areas. In addition, approximately 10 Marines and 3 helicopters from the Helicopter Atomic Test Unit, 2nd Marine Corps Provisional Atomic Exercise Brigade, participated in a test of the effects of overpressure.

For the damage effects evaluation, the 412th Engineer Construction Battalion placed barbed wire obstacles and excavated trenches, bunkers, and foxholes in the display area, which extended 3.2 kilometers (2 miles) south of ground zero. The chemical team placed film badges in the open and in the fortifications, and the 3623rd Ordnance Company placed military equipment in the display area. After the shot, the engineer team and the ordnance team returned to the display area to assess damage to the fortifications, and the chemical team retrieved the film badges.

Nancy, a 300-foot tower detonation, was fired with a yield of 24 kilotons at 5:10 a.m. PST on March 24, 1953, in Area 4 of Yucca Flat. A shift in the wind direction during the shot caused fallout in an area between the Desert Rock maneuver troops and their objective causing the shot cloud to approach the troop trenches before it was carried to the west and north. The peak intensity noted at the trenches was 0.018 R/h.

An estimated nine Marine and four helicopters were involved in an operational helicopter test. Three helicopters hovered about 18 kilometers (11.2 miles) southeast of ground zero to experience the shock wave and a fourth helicopter was parked 15 kilometers (9.3 miles) southeast of ground zero. Two of these helicopters flew toward ground zero and one attempted to land to check the radiation intensities surrounding ground zero. However, thick dust and residual radiation intensities prevented it from landing.

⁵ Jean Ponton, Operation Upshot-Knothole, 1953, 3-10.

⁶ Defense Threat Reduction Agency Fact Sheet. Operation Upshot-Knothole. Fort Belvoir, Va., September 2021.

Damage effects evaluation teams compared the pre-shot and post-shot conditions of fortifications and materiel placed in the display area before the shot. The medical team examined the condition of sheep that had been placed 90 to 2,740 meters (0.06 to 1.7 miles) from ground zero, and the chemical team retrieved film badges placed in fortifications and on stakes in the display area.

Badger, a 300-foot tower detonation, was fired with a yield of 23 kilotons at 4:35 a.m. PST on April 18, 1953, in Area 2 of Yucca Flat. About 2,800 DOD personnel participated in troop maneuvers, volunteer officer observers, troop orientation and indoctrination, operational helicopter tests, and damage effects evaluation.

The evening before the shot, 16 helicopters flew to the staging area at Yucca Airstrip, 20 kilometers from ground zero, and remained there overnight. Before dawn on April 18, the other participants assembled to observe the shot from the trench area, located 3.66 kilometers (2.3 miles) southwest of ground zero. After the shock wave passed, the participants began the maneuver, which involved an attack on objectives 1.83 kilometers (1.1 miles) southwest of ground zero. Radiological monitoring teams preceded and accompanied the Marines. A wind shift blew the stem of the cloud over the display area and over some of the observer trenches, resulting in contamination.

Six Army and six Marine Corps officers took part in the volunteer officer observer program. These observers witnessed the shot from a trench 1.83 kilometers (1.1 miles) from ground zero. Because radiation intensities in the trench after the shot were between 30 and 50 R/h, the officers evacuated this area. They walked to a road about 180 meters (0.1 miles) west of the trenches, where they met vehicles which took them to the main trench area, 3.66 kilometers (2.3 miles) from ground zero.

Simon, a 300-foot tower detonation, was fired at 4:30 a.m. PST on April 25, 1953, in Area 1 of Yucca Flat. The SIMON device produced a nuclear yield of 43 kilotons, significantly larger than expected. Because the wind shifted at the time of detonation, radiation levels in the Desert Rock trench area were higher than anticipated. The Test Director established offsite roadblocks as a result. These were placed on U.S. Highway 91 between Las Vegas and Alamo, Nevada, and on U.S. Highway 93 between Las Vegas, Nevada, and St. George, Utah.

Tactical troop maneuvers, the largest Desert Rock program at SIMON, engaged 2,450 Army personnel. The exercise, designed to provide realistic combat training under the conditions of a nuclear battlefield, was preceded by an orientation and rehearsal. The exercise itself consisted of observing the shot, conducting a ground attack, and inspecting the display areas. For the attack, troops were divided into two BCTs, which were to capture an object about 750 meters (0.5 miles) west of ground zero. Two radiological monitoring teams preceded the troops to the objective and display areas, and additional monitors accompanied each BCT during the attack. The BCT to the east, which was closer to ground zero, was halted 1.83 kilometers

(1.1 miles) from ground zero when the monitors detected radiation intensities of 2.5 R/h. The other BCT, approaching on the west, continued to advance and presumably reached the objective. After the ground attack, troops viewed the display area south of ground zero. Because Simon produced more widespread contamination than most of the previous UPSHOT-KNOTHOLE shots, several displays were inaccessible; forward movement was halted at the 1.83-kilometer (1.1-mile) display line, where the radiation intensity was near the limit of 2.5 R/h.

Seven Army officers and one Navy officer participated in the volunteer observer program at Shot SIMON. These volunteers chose to occupy trenches 1.83 kilometers (1.1 miles) from ground zero. Seconds after the burst, one officer measured a radiation intensity of 100 R/h, which dropped to roughly 20 to 25 R/h within one minute. As the volunteers left the trenches and walked away from ground zero, radiation levels steadily declined, except when the officers stopped to tour the display area. The group walked about 400 meters (0.2 miles) before they were met by trucks and driven to the main trench area.

For the damage effects evaluation, personnel from the 412th Engineer Construction Battalion and the 3623rd Ordnance Company prepared a display area 230 to 3,200 meters (0.1 to 2 miles) south-southeast of ground zero. Equipment, sheep, and film badges were placed in fortifications and in the open. After the shot, engineer and ordnance teams inspected equipment and fortifications to assess the damage caused by the detonation. A medical team retrieved the sheep, and a chemical team retrieved the film badges for analysis.

Encore, an airdropped nuclear device, had a yield of 27 kilotons. A B-50 from Kirtland Air Force Base delivered the ENCORE device, which was detonated 2,423 feet above Area 5 of Frenchman Flat at 8:30 a.m. Pacific Daylight Time (PDT) on May 8, 1953. The bomb was off-target by 250 meters (0.2 miles).

Although the scientific activities at Encore were extensive, more than 3,000 individuals took part in observer programs, troop maneuvers, operational helicopter tests, and damage effects evaluation.

For several days before the shot, maneuver troops attended classes and practiced their shot-day activities. They observed the shot with the other troops in trenches 9.4 kilometers (5.8 miles) from the intended ground zero. The trenches were far enough from the shot that troops and other observers were allowed to rise to look at the fireball before the shock wave arrived, a change from previous policy.

After the shot, the two BCTs began the ground assault on two objectives, about 5 kilometers (3.1 miles) southwest and 1.4 kilometers (0.9 miles) southeast of ground zero. While the ground troops were marching from the trenches to the objectives, seven H-19 helicopters were airlifting one 30-man platoon from each BCT to the closer objective. The first group to arrive at that objective was a pathfinder team, which included a radiological safety monitor. This monitor took a reading of 0.26

R/h about one hour after the detonation in the vicinity of ground zero. After spending about 7 hours in the forward area, the troops returned to Camp Desert Rock.

For damage effects evaluation, the 412th Engineer Construction Battalion excavated bunkers, trenches, and foxholes and built two sections of bridging. The 3623rd Ordnance Company placed equipment in the display area, which extended 3.2 kilometers (2 miles) to the southeast of ground zero. In addition, a medical evaluation team placed sheep in the area the day before the shot, and a chemical team placed film badges in the fortifications. After the shot, evaluation teams entered the display area to assess damage and to retrieve the animals and film badges for analysis.

Grable, the tenth test of UPSHOT-KNOTHOLE, was detonated with a yield of 15 kilotons (9.3 miles) at 8:30 a.m. PDT on May 25, 1953. A 280mm cannon fired the atomic artillery projectile, which detonated 524 feet above Area 5 (Frenchman Flat).

More than 2,600 exercise troops and over 700 observers participated in Grable, including members of each of the armed services, witnessing the shot from trenches 4.57 kilometers (2.8 miles) west of ground zero. After the shot, observers were to inspect the equipment display area, but due to a dust storm, they were unable to approach closer than 1.37 kilometers (0.9 miles) to ground zero.

After observing the shot, the exercise troops were to attack two objectives located 2.4 kilometers (1.5 miles) southeast of ground zero and 2.8 kilometers (1.7 miles) east-southeast of ground zero. High winds and dust forced the troops to turn back about an hour after the attack began, although some troops did approach as close as 700 meters (0.4 miles) to the south of ground zero and were able to view the equipment display up to 450 meters (0.3) from ground zero.

For the damage effects evaluation the 412th Engineer Construction Battalion excavated trenches, bunkers, and foxholes and constructed sections of bridging in the display area southeast of ground zero. The 3623rd Ordnance Company also placed military equipment in the area. Army personnel placed sheep and dosimetry instruments in these fortifications for use in medical and shielding evaluations. After the shot, engineer, ordnance, chemical, medical, and quartermaster teams evaluated the damage to equipment, animals, and fortifications. A veterinary officer and technician evaluated the effects of the detonation on the sheep, and a chemical team retrieved dosimetry instruments.

Upshot-Knothole's large number of tests, coupled with the rapidity of their execution, testified to the maturation of the United States' weapon test program. This maturation paved the way for the increasing number of tests executed both in Nevada and in the Pacific. Other measures of maturation include the continued close cooperation between the AEC and the DOD as well as the

participation of the FCDA and the press. Upshot-Knothole inextricably linked AEC and Los Alamos to the goals of the DOD and the interests and concerns of society.

Operation Upshot-Knothole⁷

Test	Date	Sponsor	Type	Surface Elevation (ft)	Purpose	Yield Range (kt)
Annie	03/17/1953	LANL	Tower	300	Weapons Related	16
Nancy	03/24/1953	LANL	Tower	300	Weapons Related	24
Ruth	03/31/1953	LLNL	Tower	305	Weapons Related	.2
Dixie	04/06/1953	LANL	Airdrop	6022	Weapons Related	11
Ray	04/11/1953	LLNL	Tower	100	Weapons Related	.2
Badger	04/18/1953	LANL	Tower	300	Weapons Related	23
Simon	04/25/1953	LANL	Tower	300	Weapons Related	43
Encore	05/08/1953	LANL/DoD	Airdrop	2423	Weapons Related	27
Harry	05/19/1953	LANL	Toer	300	Weapons Related	32
Grable	05/25/1953	LANL	Airburst	524	Weapons Related	15
Climax	06/04/1953	LANL	Airdrop	1334	Weapons Related	61

⁷ Derived from DOE/NV – 209, REV 16, September 2015.